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THESIS

A METHOD TO INCREASE THE VALIDITY OF MEASURING POSTURE

Submitted by

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(B.S. in Educ. University of Illinois, 1935)

In partial fulfillment of requirements
for the degree of Master of Education

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CHAPTER 1

INTRODUCTION

At the present time the methods of grading posture range from the simple window pole test to the more complicated methods of determining body angles that require intricate apparatus. Regardless of the methods used to determine one's posture, we must first of all know what good posture is. It is essential, therefore, that we have a standard of comparison, or, a norm. Without this the results would be meaningless. One need look no farther than the home to find several standards. The foot rule is a standard for linear measurement, the quart measure is a standard of liquid measurement, while the simple scale is a standard of weight. The necessity for standards are so essential that they are universally accepted. The social and economic times demand standards. As a matter of fact the Department of Weights and Measures in Washington, D.C. have on file a sample of each weight and measure to be used as a standard. A pound in Boston is the same as a pound in Los Angeles, while a quart in one part of the country is the same as a quart in another part.

If two objects are compared to a standard then the relationship between the two objects can be determined, but

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If two objects are compared to a standard then the relationship between the two objects can be determined, but

if the same objects are not compared to a standard then the relationship between them remains unknown. For instance, let's compare two objects to a pound weight. The first object is just twice as heavy as the weight, while the second is four times as heavy as the weight. Now we not only know the exact weight of each object, but we can compare the two against each other and show that one is twice as heavy as the other. Maybe the smaller object was the heavier, or, maybe the two appeared the same weight, but regardless of how they appeared, with a standard of comparison we have an accurate measurement.

The question naturally arises are standards used in posture rating, and do the standards agree with each other? One standard says that if an individual's horizontal height equals his vertical height he has good posture, while another standard says that if certain of the body segments are in such a position that a plumb line will bisect them, then that individual has good posture. Another method used is to compare an individual, or his picture, to a master chart and determine his rating from the picture on the chart with which he is most closely identified. A method commonly used is the subjective method, or, guessing the grade after a visual inspection, based on the opinion of the examiner. Needless to say the standard of good posture is only in the mind of the judge. If the judge's standard of good posture happens to be erroneous then of course all deductions are erroneous

also. Each judge has his own personal mental standard, and the standards vary as much as the judges themselves. Cureton[1] found that this subjective method of grading posture was nearly 13.4 percent better than pure chance guesses on the average, while Brownell[2] showed that even with experts doing the rating some individuals were given a rating of A,B, C, and D. That is, one subject was judged as best by one judge and poorest by another judge. This subjective method is frequently used in grading silhouettes. It is obvious therefore, that some method of grading posture from the silhouette is needed which will increase the validity and reliability of the present method. Such a method will be discussed that will not only increase the validity and reliability, but is also time saving and economical.

[1] Cureton, T.K. "Reliability and Objectivity of the Springfield Postural Measurements," Supplement to the Research Quartly of the American Phys. Educ. Ass. May, 1935

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CHAPTER 2

REVIEW OF RELATED STUDIES

AN EARLY STUDY

As far back as 1907 an anthropometric apparatus consisting of a seat with movable back and arm support was devised. The foot rests were adjustable for each foot separately, with twenty measurements being secured in rapid succession.

RELATION BETWEEN STANDING AND LYING HEIGHT

It has been believed that a possible index of posture exists between the standing and lying heights since it appears likely that there would be less difference between the two measurements in the case of a person who stood fully erect, than the case of one with a slouch.

THE WINDOW POLE TEST

One of the simplest methods of grading posture adaptable to the school room use is the simple window pole test. The child is asked to stand in his normal posture while the teacher places the window pole beside the child. If the child has good posture the pole will pass along the following points:

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1. Tragus of the ear.
2. Middle of tip of shoulder.
3. Middle of greater trochanter.
4. Back of patella.
5. In front of outer malleolus

Any deviation from this line indicates that some body segment is out of line. This test is quite simple and is often used where other methods are not practical.

CRAMPTON'S[1] BACK WALL TEST

In this test the student stands with his heels, hips, and shoulders against the wall. He then slides his hand in the space between the wall and his lumbar spine. The hand usually fits loosely. In an attempt to make the fit more snug, the individual tries to press the lower part of his back against his hand. In doing this he automatically corrects his posture, that is, he draws his abdomen in, lifts his chest, and assumes a better body position. His next task is to walk away from the wall and maintain his correct posture.

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6

THE SCHEMATOGRAPH

The Schematograph is a device to secure a quick and fairly accurate record of the pupil's standing position. The apparatus is so constructed that it makes it possible to trace the form of the pupil on a piece of paper. The method is less expensive than photography and serves the purpose of supplying a picture of the individual's pose.

The construction of the schematograph is quite simple and inexpensive. Secure an old square-cased camera. Then, leaving the lense as found, place a mirror directly in back of the lense, facing the aperture and at an angle of 45 degrees to the bottom of the case. The top of the film chamber is removed and replaced by a piece of glass. When an undressed person is placed in front of the camera, with the side of his body towards the lense and with lights shining on the back and front of him, a piece of tissue paper is placed on the new glass top of the camera. The image of the subject is reflected by the mirror below. The contours of the image when traced on the paper give a graphic record of the body contours. A tracing of this record as a pattern on black paper and then cut from the black paper on the outline would give as a final result a black silhouette.

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A DEVICE BY GOLDTHWAIT

A newer method used at Harvard and devised by Goldthwait,[1] is to take the silhouetteograph and place dots on the picture at the following places:

1. Mid-cervical region, at level of jaw angle.
2. Mid-dorsal region.
3. Mid-lumbar region.
4. Pelvic region, at middle of inclination of pelvis.

A line is drawn through the first two dots extending down to the feet and above the head dots("1" and "2"). A line is then drawn through dots "3" and "4" in like manner. A postural rating is then made by measuring the angle formed by the intersection of the two lines. The suggested rating scale is as follows:

"A" 1 to 10 degrees

"B" 11 to 20 degrees

"C" 21 to 30 degrees

"D" 31 to 40 or more degrees

[1] Goldthwait, Joel "The Relation of Posture to Human Efficiency," Amn. Jour. of Orthopoedic Surg.,7:372, 1909

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A newer method used at Harvard and devised by Goldthwait, is to take the silhouettegraph and place dots on the picture at the following places:

1. Mid-cervical region, at level of low angle.
2. Mid-dorsal region.
3. Mid-lumbar region.
4. Pelvic region, at middle of inclination of pelvis.

A line is drawn through the first two dots extending down to the feet and above the head dots("1" and "2"). A line is then drawn through dots "3" and "4" in like manner. A postural rating is then made by measuring the angle formed by the intersection of the two lines. The suggested rating scale is as follows:

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MISS DREW'S METHOD

Miss Drew records a method of grading posture which uses the "A", "B", "C", and "D" rating.[1] Her method rates points for various parts of the body as follows:

Head.....3 points
Chest.....3 points
Dorsal curve.....3 points
Lumbar curve.....3 points
Abdomen.....3 points
Weight distribution.....5 points

Total points 20

"A" equals 20 points which is credited as 100 percent. Her complete table is as follows:

Grades	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
Points	20	19	18	17	16	15	14	13	12	11	10
Percent	100	95	90	85	80	75	70	65	60	55	50

THE UNIVERSITY OF OREGON

The University of Oregon has a group rating system which is a little more inclusive than Miss Drew's. The Oregon system is as follows:

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Ankles straight.....1 point

Weight properly distributed.....1 point

Abdomen in and lower back not unduly curved.5 points

Chest lifted.....2 points

Shoulder blades flat.....1 point

Shoulders not hunched.....1 point

Head held erect.....3 points

Total marching score 0 to 15

This is recorded as 0, 10 or 15

Possible final score 0 to 30

LOWMAN'S GROUP EXAMINATION

Lowman[1] has a group examination system which results in a rough classification of the obvious defects of the body mechanics such as weak ankles, flat feet, knock knees, round shoulders, round or hollow backs, unlevel hips and shoulders etc.

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Shoulder blades flat.....1 point

Shoulders not humped.....1 point

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Total marching score 0 to 15

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THE BANCROFT TEST

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THE CONFORMATUER

The Conformatuer is a device designed to fit the spine and take its shape. Cureton[1] has perfected a conformatuer which consists of a series of wooden rods which slide in and contact the spine. There are spring attachments for locking the rods after they are pushed into place. Measurements are taken at the following points:

1. The seventh cervical spinous process
2. The maximum lateral displacement of the thoracic spine.
3. The maximum lateral displacement of the lumbar spine.
4. The maximum lateral displacement of the posterior spine of the sacrum.
5. The location of the internal malleoli.

CENTER OF GRAVITY

This method of determining the center of gravity as devised by Lovett[2] is a specially contrived balance that

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enables the observer, through computation of the weight of the individual with other points, to erect a vertical line drawn through this point.

This balance shows that a vertical line drawn through the center of gravity passes in front of the ankle joint, in front of the knee, and in front of all the vertebral column except possibly a little in the lumbar region.

THE ANTERO-POSTERIOR CENTER OF GRAVITY TEST

More recent work has been done on the center of gravity test by Cureton.[1] His procedure is as follows.-

1. The subject is asked to step upon the balance board and face in the direction of the length of the board. The internal malleoli are lined up even with the vertical pin which is located in the exact center of the board. The board is supported at both ends from the center of each scale.

2. The subject is instructed to stand in a normal postural position without stiffness and to maintain balance as perfectly as possible, and to continue to look straight ahead throughout the test.

3. The examiner balances the scales, first the forward one then the rear scale, until both scales have their

[1] Cureton, T.K. "Reliability and Objectivity of the Springfield Postural Measurements," "Supplement to the Research Quarterly of the American Phys. Educ. Ass., Vol. 6 No. 2 May 1935

lever arms swinging freely between the guide stops. The subject is then told that he may step down from the balance board. The scales are read and both readings recorded. One-half of the weight of the board is deducted from each reading.

4. The calculation is made, preferably on a slide rule, or the reading taken from a prepared table. The results show exactly how far the center of gravity is being balanced in front of the internal malleoli.

5. The absolute center of gravity result is converted into a percentile score by means of a normal curve chart or scale.

THE OLD SILHOUETTEOGRAPH

An inexpensive method of photographing children by means of a silhouetteograph camera was advocated by Fradd.[1] The equipment used by him included a screen of architect's tracing linen mounted on a frame about 7 feet high and 3 feet wide, and illuminated by a 1000-watt electric light placed 3 to 5 feet behind it. The child stands sideways

[1] Fradd, Norman W., "A new method of recording posture." Journal of Bone and Surgery, Vol. 5, No. 4, pp. 757, 758. October, 1923

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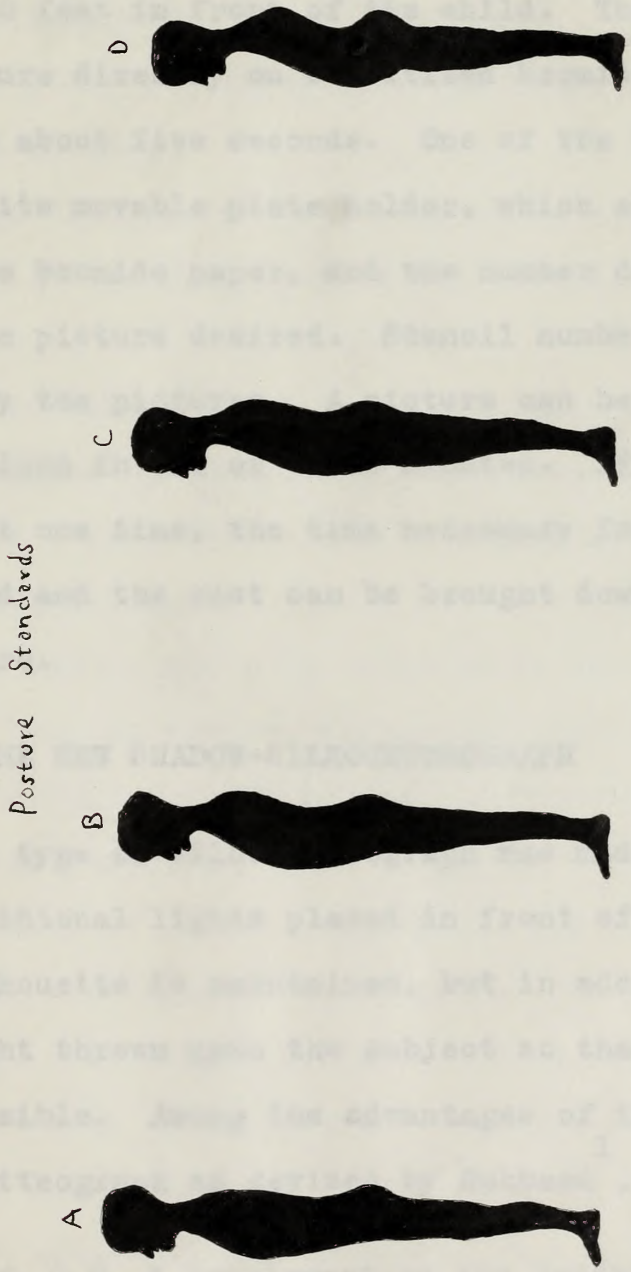
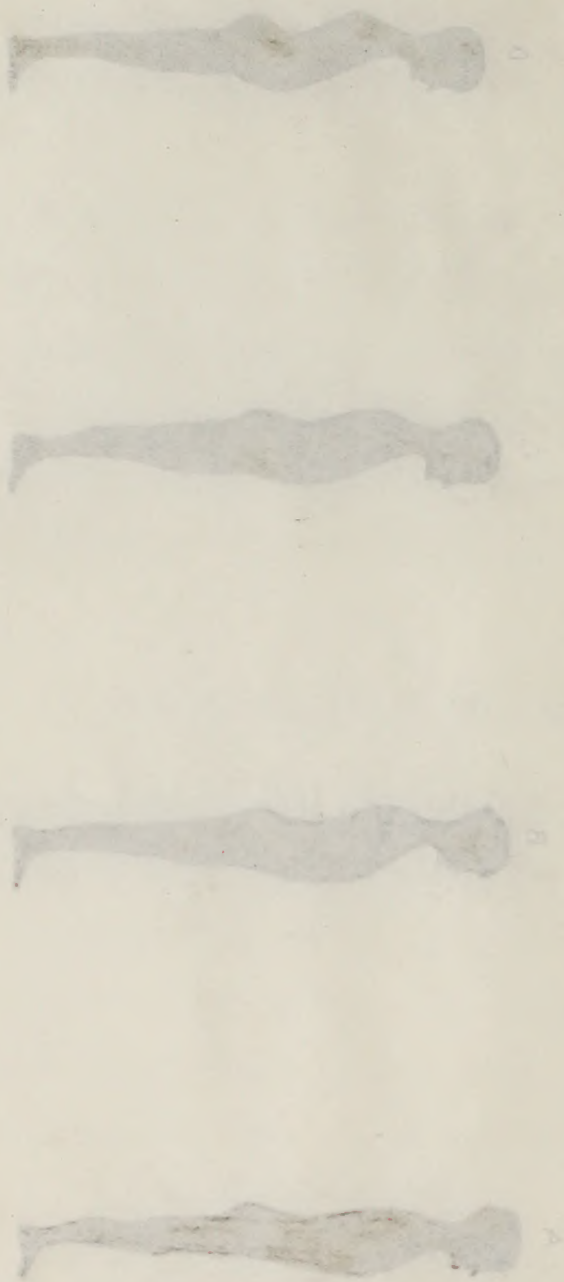


Figure I



directly in front of the screen, so that a photograph produces a profile silhouette. The silhouetteograph camera is placed about 10 feet in front of the child. The camera takes the picture directly on sensitized bromide paper with an exposure of about five seconds. One of the features of the camera is its movable plate holder, which allows multiple exposure on the bromide paper, and the number depending on the size of the picture desired. Stencil numbers on the screen identify the pictures. A picture can be taken, developed, and fixed in two or three minutes. If a large number are done at one time, the time necessary for each picture is reduced and the cost can be brought down to about 1 cent per picture.

THE NEW SHADOW-SILHOUETTEOGRAPH

The new type of silhouetteograph was made possible by the use of additional lights placed in front of the screen. The actual silhouette is maintained, but in addition there is sufficient light thrown upon the subject so that a shadow picture is possible. Among the advantages of this new type shadow-silhouetteograph as devised by Hubbard[1], over the

[1] Hubbard, C.H. " Supplement to the Research Quartly," March I935

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[1] Hubbard, U.K. " Amusement is the Research Quarterly," March 1933

old type are the following:

1. The difference in height of the shoulder blades is clearly shown.
2. The direction of the spine is portrayed without special marking.
3. Muscular development is easily seen.
4. A check on the pronation of the feet is made possible.
5. Negatives which will respond nicely to photostatic reproduction and enlargement are available in case there is a need for further and more detailed study of the individual.
6. The new method makes it possible to place markings on the body at special places with red grease paint crayons for the purpose of securing better check on alignment, etc.

The battery of lights responsible for the more detailed picture is divided into two parts, one on each side of the subject. The lights are fastened to standards which are hooded carefully by screens and adhesive tape over cracks so that light will not be admitted to the camera. Three 200-watt lamps are evenly spaced on a vertical line on each upright standard. Standards are painted white so that as little light as possible will be absorbed by them; and practically all of it throw upon the subject. They

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The battery of lights responsible for the more detailed picture is divided into two parts, one on each side of the subject. The lights are fastened to standards which are hooded carefully by screens and adhesive tape over cracks so that light will not be admitted to the camera. Three 500-watt lamps are evenly spaced on a vertical line on each upright standard. Standards are painted white so that as little light as possible will be absorbed by them; and practically all of it thrown upon the subject. They

are raised sufficently high off the floor to illuminate from head to foot.

The old method required a I000-watt lamp in back of the screen. To this has been added a 500-watt lamp and used to throw more light down to the region of the ankles and arches. The I000-watt lamp and 500-watt lamp are added to the six 200-watt lamps on the standards in front of the screen. These require an extra-heavy fuse unless the load is divided between two power lines.

The camera is placed ten feet in front of the screen. The subject stands directly in front of the screen. The standards of lights are placed three feet in front of the subject and a little to each side so as not to obstruct the view from the camera.

The material used in the new type silhouetteograph is exactly the same as used in the original, namely, 5x7 inch photographic printing paper.

The time required to take and develop the pictures is also the same as the old type silhouetteograph.

CHAPTER 3

THE COMPAROGRAPH

The Comparograph is a method of taking shadow-silhouetteographs in which, when the pictures are developed, the subject's posture is contrasted with excellent posture all in the same picture. In other words, an outline or a norm is painted on the curtain before which the subject stands. The outline is plainly seen all around the individual. Any deviation from the norm may be detected in a glance. The outline is a standard of excellent posture. It does not vary from time to time. It is stable and consistant. The same norm is used on all tests, and the subjective judgement , or the judges opinion of excellent posture, is eliminated.

The lack of validity from subjective judgement was clearly shown by Cureton[I] when he found that this method when used even by experienced examiners who had worked together for three years was only 13.4 percent better than pure chance guesses as an average in ranking pupils.

[I] Cureton,T.K. "Reliability and Objectivity of the Springfield Postural Measurements," Supplement to the Research Quartly of the American Phys. Educ. Ass. May 1935

THE COMPAROGRAPH

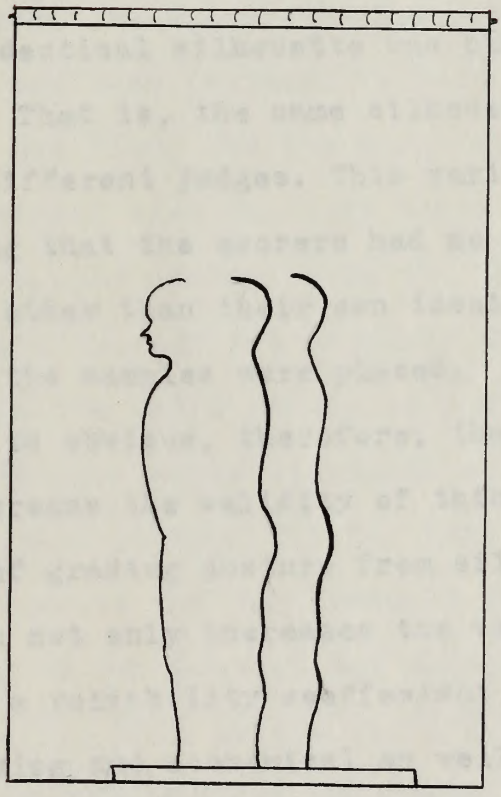
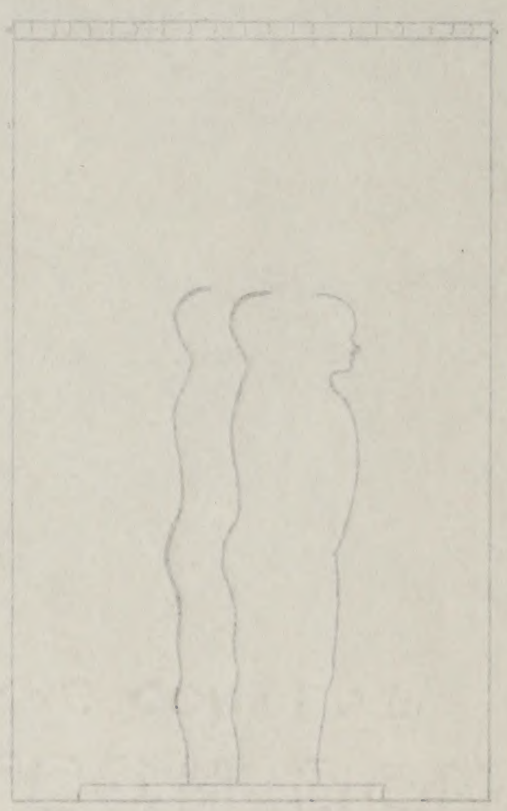


Figure 2



This finding was substantiated by Brownell[I] when he found that using ten competent judges, including two authorities on posture, and having them grade silhouettes and assign them a value of A,B,C, and D depending on the standard of excellence as judged by the examiner, that considerable variation existed. The compiled results showed that an identical silhouette was placed in each of the four groups. That is, the same silhouette was called A,B,C,and D by different judges. This variation was explained by saying that the scorers had no standard for their judgement other than their own ideals of good posture at the time the samples were placed.

It is obvious, therefore, that some method is needed to increase the validity of this present subjective method of grading posture from silhouettes. The The Comparograph not only increases the validity 47.5 percent and has a reliability coeffecient of .79, but is also time saving and economical as well.

[I] Brownell, C.L. " A Scale For Measuring The Antero-Posterior Posture Of Ninth Grade Boys," Teachers College, Columbia University Contributions To Educ. No. 325

HOW THE NORM WAS ESTABLISHED

The norm used as the outline was set up as the standard of excellent posture by Klein[I]. This standard is a composite silhouette based on the examination of 2200 subjects. In establishing the standard the head was balanced above the shoulders, the chest elevated and the breast bone the part of the body farthest forward, the lower abdomen drawn in and flat, and the back curves not exaggerated. In the lateral view the body parts were so aligned that a perpendicular dropped from the ear or just behind it, would fall through the shoulder and hip joints, and either through the ankle joints or just in front of them. Whether this particular standard, or some similar standard, is used matters little. Some standard must be accepted which meets the requirements of excellent posture according to our present day knowledge of what excellent posture is. This particular standard is merely one of several possible choices and meets the accepted requirements. It includes all the characteristics of excellent posture.

[I] Klein, Armin. " Posture and Physical Fitness". U.S. Dept. of Labor. Bureau Publication 205

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WHERE THE NORM WAS OBTAINED

The norm used on the curtain was taken from the excellent posture standard as set up by the U.S. Department of Labor.[I] (same as standard in publication No. 205)

HOW IT WAS PUT ON THE CURTAIN

The process of taking a two and a half inch silhouette and tracing it on a curtain as a six foot four outline, was quite simple. First of all the silhouette was traced on a small piece of cellophane and then placed between two pieces of glass 3¼X4 inches. This homemade slide was then placed in an ordinary slide projector used for projecting still slides, and the silhouette was cast onto the black curtain that had been tacked on the wall. With the outline enlarged to the proper size and the curtain lined with a plumb line, the front, or anterior portion of the silhouette, was traced with chalk. Instead of tracing the posterior part of the image as it was, it was moved outward four inches,and traced.The tracing then looked like that of a man who had been sliced from head tofoot, anterially-posterially, and both sections moved apart four inches. Instead of stopping at this point the posterior,

[I] U.S. Department of Labor, "Posture Exercises", Children's Bureau Publication No. 165

or back outline, was again moved out four inches and traced. As the traced outline now appears on the curtain, there is one tracing of the anterior of the standard, or norm, and two tracings of the posterior, with the first posterior tracing just four inches spread from its original position, and the second tracing four inches from the first posterior outline. The instep of the foot was not traced as other methods of measuring the feet are used. The outline instead was continued downward. By experimenting it was found that all subjects in the college could fit into the outline as described above. Several outlines were made before the proper demensions were found. Needless to say if girls of college age are to be studied, an outline made by using perfect posture for women would be used.

This study is limited to boys of college age, but the principle would remain the same regardless of the age or sex of the subjects used.

HOW THE STANDARD IS ADJUSTED

The question naturally arises, how can the outline, or the norm, be adjusted to all the subjects? First of all the outline is attached to a roll like the curtain in any window. The roll then can be moved up and down to care for variations in height. The range of height of the subjects studied was from six feet four inches to five feet two

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inches. The outline easily moved up and down to meet these requirements. As there are no feet on the outline, the outline of the leg was continued downward. Therefore variations in height could be met. The next problem that naturally arises is caring for the variations in width. The weight of the subjects studied ranged from 220 pounds to 118 pounds, yet the outline could be adjusted to meet these variations. If the subject was of the thin type the inside outline was used while if he was of the stocky type then the outside outline was used. The anterior portion of the outline was used for all subjects, while in the posterior , if a thin subject was being used, then the outside outline would be covered by a strip of black cloth. It will be remembered that there are two posterior outlines. If a stout subject is used then he of course covers the inside outline himself so there is no need of covering that line. As will be described under the technique of taking the picture, one spends little time moving the curtain up and down and removing the strip. With a little organization this may be cut down so the time spent is negligible.

PLACING THE CAMERA

The camera must be placed at such a distance from the image that the image is in clear focus. This distance is determined by opening the shutter in the lense and looking

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at the ground glass plate in the back of the camera. By moving the camera back and forth and adjusting the bellow focus a clear inverted image may be seen on the glass. When the image is clearest and when it is all visible on the glass, then the correct focus has been obtained. This will be found to be approximately 8 to 10 feet from the subject.

PLACING THE LIGHTS

The number of lights used and the placement of the lights varies. Some use more lights than others. Naturally the length of the exposure depends on the number of lights used, the type of lense, and the stop open used. The same results may be obtained in various ways. The method used here is one of several possible methods. Satisfactory results may be obtained by using two number two photoflood lights shining on the image from an angle of about 45 degrees and a few feet in front of the camera. Care must be taken that there is no light allowed to escape from the reflectors and shine back into the camera. There are no other lights, either in back of the curtain or in front with the possible exception of the ordinary room light.

HOW SUBJECTS ARE IDENTIFIED

It would be difficult to identify the individuals from their pictures if some method of numbering them were

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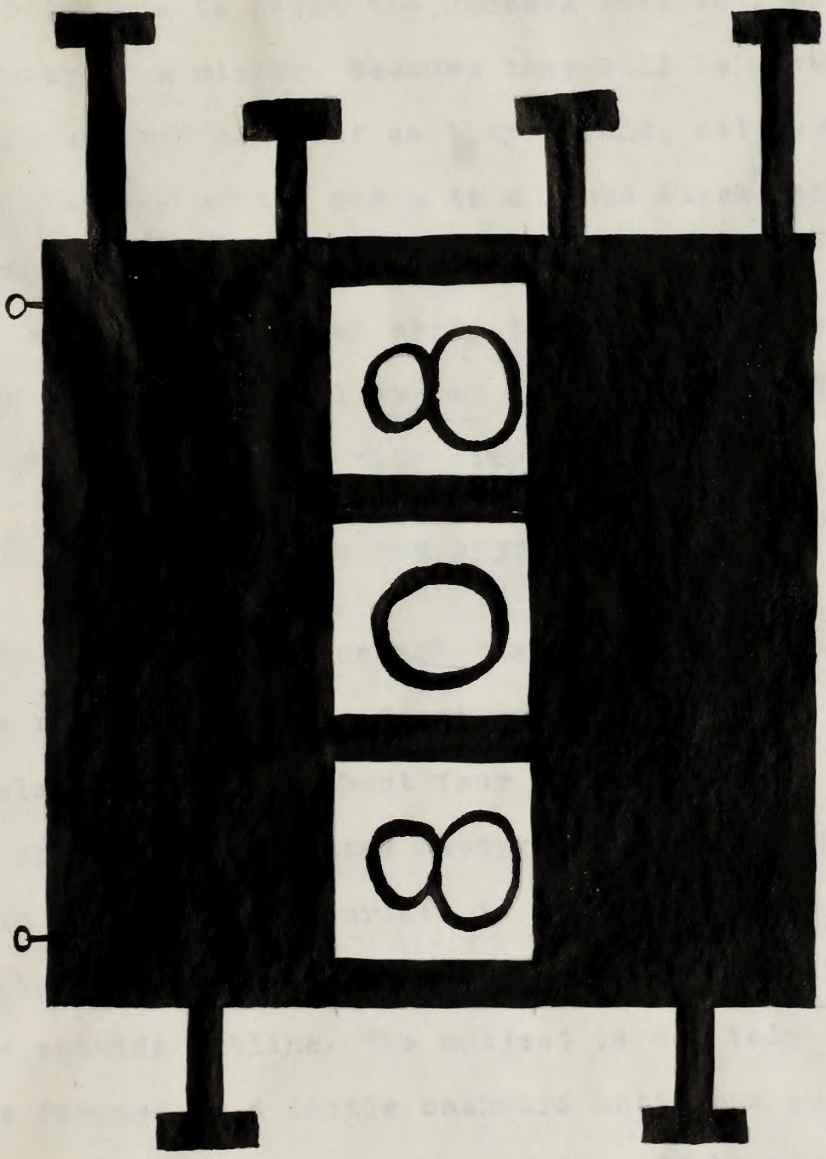

Figure 3

Figure 3

not possible. A simple method of numbering the pictures and one that can be easily applied is to take three strips of paper and paint the numbers from one to ten on each strip. It is wise to paint the numbers inverted, or as they would appear in a mirror, because they will be inverted in the picture and come out as they should, not backwards. Now glue each end of the strip to a round stick and wind it up. A frame may be made with an opening just large enough to allow one number of each strip to show. As the round rod is turned the numbers will appear in succession. There are a total of 999 numbers on this simple contrivance.

TAKING THE PICTURE

With all the apparatus set the subjects are called in to be photographed. The first subject standards on the little platform that is about four inches high. On the top of this platform are painted footprints on which the boy stands in the nude. The curtain is then lowered to the desirable height. The boy is slim so the strip is left pinned over the outside outline. The subject is now told to move a little forward or a little backward until the outline can be clearly seen on all sides of him. If he was in this position originally he would be asked to hold the position and his picture would be taken. The exposure is about three seconds with the largest stop opening. As each in-

dividual steps down from the platform he signs his name on a piece of paper opposite the same number that appeared on the screen. Before stepping up on the platform each boy turns the number chart to the next number. The next subject should be a boy who is about the same size and build as the boy before him. By doing this many pictures can be taken without moving the screen. When the stout boys come along the strip is merely removed and only a few changes in height are necessary. Some times only a few adjustments are necessary in a whole class if they are of about the same general size. To make adjustments a boy may be stationed at the curtain, raising and lowering it according to your directions. With a little exerience a whole class may be photographed with but one change made in the width and but a few changes made in the height.

The difficulty might arise that some boys have longer legs than bodies, while other boys have longer bodies than legs. How does the standard on the screen fit them all? The standard on the screen is not intended to fit the individual nose for nose, chin for chin, knee cap for knee cap etc. Naturally individuals vary in body proportion, but the characteristics of good posture remain the same. It is easily seen whether the individual follows the general contours of the outline whether his knee

cap is a little higher than that of the outline. If for instance a boy with good posture was on the platform and the standard, or outline, was raised so it was a little higher than the boy, it still would be easy to see the boy followed the general contours of the outline even though point for point he did not line up exactly opposite the outline. It has been found that when one important point on the subject and outline are lined up correctly the other points are so nearly lined up that little difficulty is witnessed in noting any deviation from the general contours of the standard.

The pictures are taken on 5x7 bromide paper, four pictures to one piece of paper. There is no negative to be redeveloped as the picture comes out on the original paper. The cost is less than a cent apiece. Besides taking an anterior-posterior of the subject, a picture of the back is taken also. However, this study is interested primarily in anterior-posterior posture so a discussion of this latter aspect will not be included at this time.

DEVELOPING THE PICTURE

The pictures are developed like any other pictures. The paper is removed from the slides in a dark room and placed in a tray of developer. When the picture is developed sufficiently it is removed, rinsed, and placed in the hypo to set. From here it is again rinsed and

placed On a towel to dry. The whole process takes but a few minutes and can be done by anyone. After the pictures are dry they are cut apart as there are four pictures on one piece of paper.

GRADING THE PICTURES

Using the outline as the standard of comparison rather than the old method of using one's own mental standard which has been proven to be very poor, the pictures are graded according to any deviation from the outline. For instance a hollow back would show more space between the back of the outline than between the outline and other parts of the body. In excellent posture the outline would be about the same distance away from the picture all around. Any deviation from this could be detected in a glance. A protruding abdomen might protrude outside the outline if it were bad enough, while winged scapular might protrude past the outline in the region of the shoulders. The boys themselves get great delight from inspecting their own pictures and have little difficulty in noting their own faults. With the standard before your eyes there is little question as to whether the back is hollow or not,whether the abdomen is protruding, whether the head is forward, chest flat, shoulders round, or whether there exists a combination of any of the above defects.Regardless of who is doing the judging an abdomen

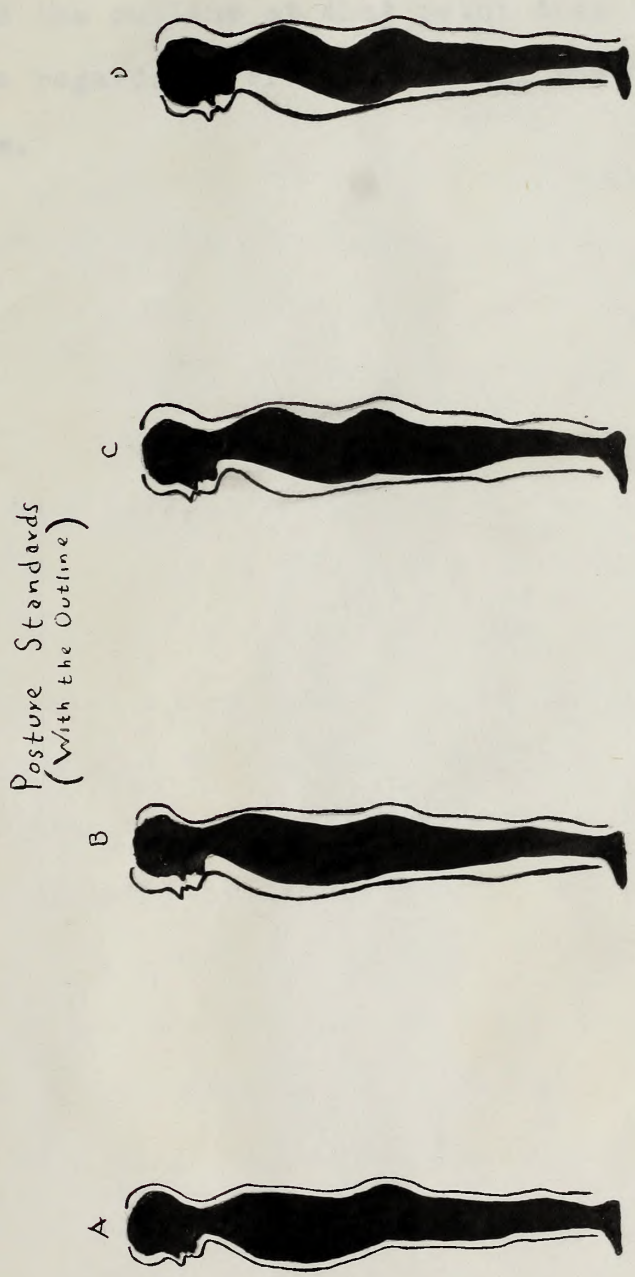

Figure 4

that is out beyond the outline is a protruding abdomen, and likewise if there is much space between the hollow of the back and the outline at that point then the subject has lordosis regardless of the personal mental standard of the judge.

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CHAPTER 4

THE VALIDITY

To determine the validity of measuring posture by by means of the comparograph, seventy-six judges were used. The judges were students in the physical education classes. They were instructed th grade ten silhouettes of known value and to give each a rating of either A,B,C, or D based on their opinion after a visual inspection. The silhouettes were shown one at a time and each grade recorded before the next silhouette was shown. Although the same silhouettes were used on the second test they were shown in a different order. The process was then repeated using the outline with each silhouette. On this second test the judges were instructed to use the outline as the standard of comparison rather than their subjective judgement.

From the results of the two tests a comparison was made between the actual rating and the judges award. If the actual rating was "A" and the judge called it "B" then one point was taken off, while if he called it "C" then two points were taken off, and three points off if he called it "D". The total number of points from the correct answers were then added up.

Without the aid of the outline the judges were a total of 349 points from the correct answers, while with the outline they were but 238 points off. In other words by using

the outline the judges were able to increase the accuracy of their judgement by 46 per cent.

After the lapse of about eight weeks the two tests were repeared. This time the subjective judgement of the judges was a total of 402 points away from the correct answers while using the comparograph they were but a total of 269 pointa away from the correct answers. On this second test the validity of the judges was increased 49 per cent by using the comparograph. The average increase in validity by using the comparograph over the subjective judgement method is 47.5 per cent.

A COMPARISON OF THE PERCENT OF ERROR BETWEEN THE SUBJECTIVE JUDGEMENT AND THE COMPAROGRAPH

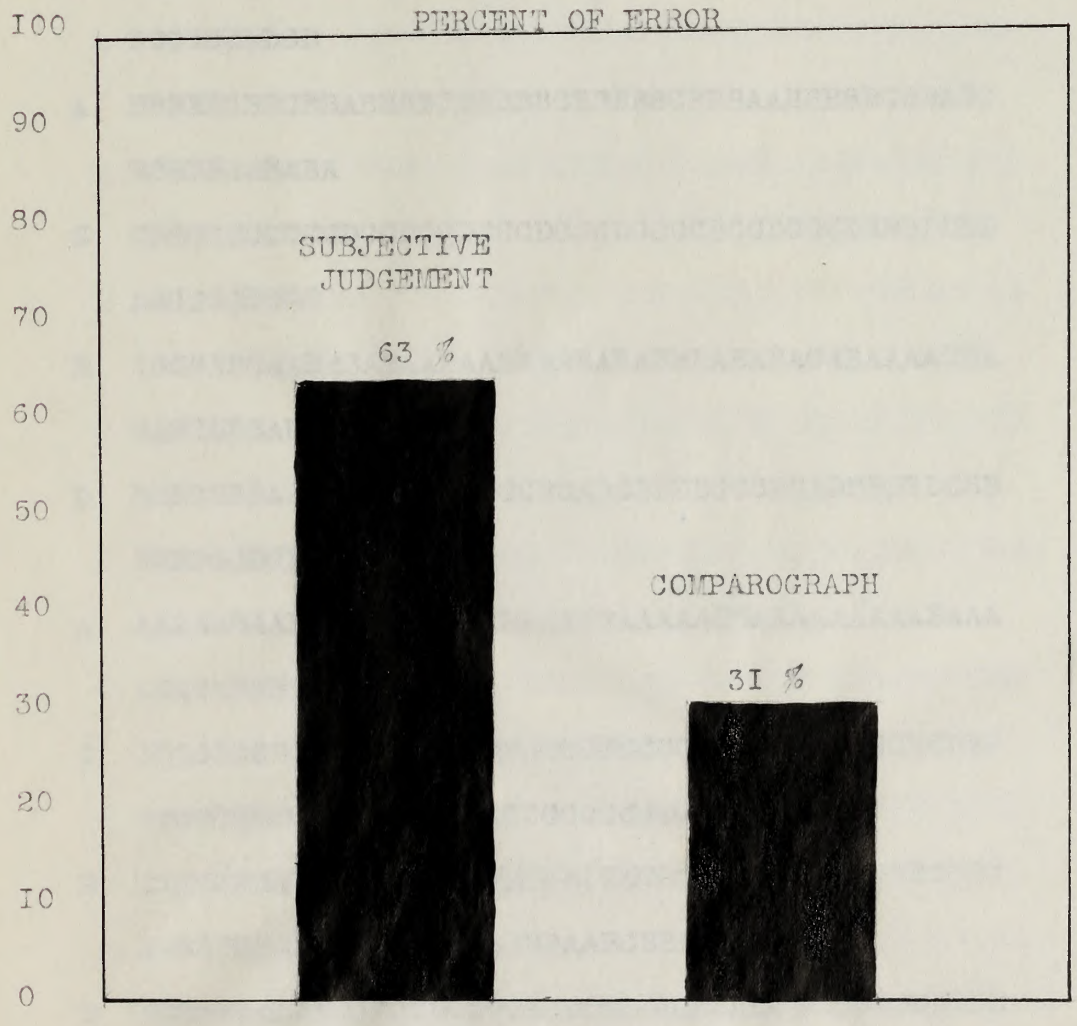
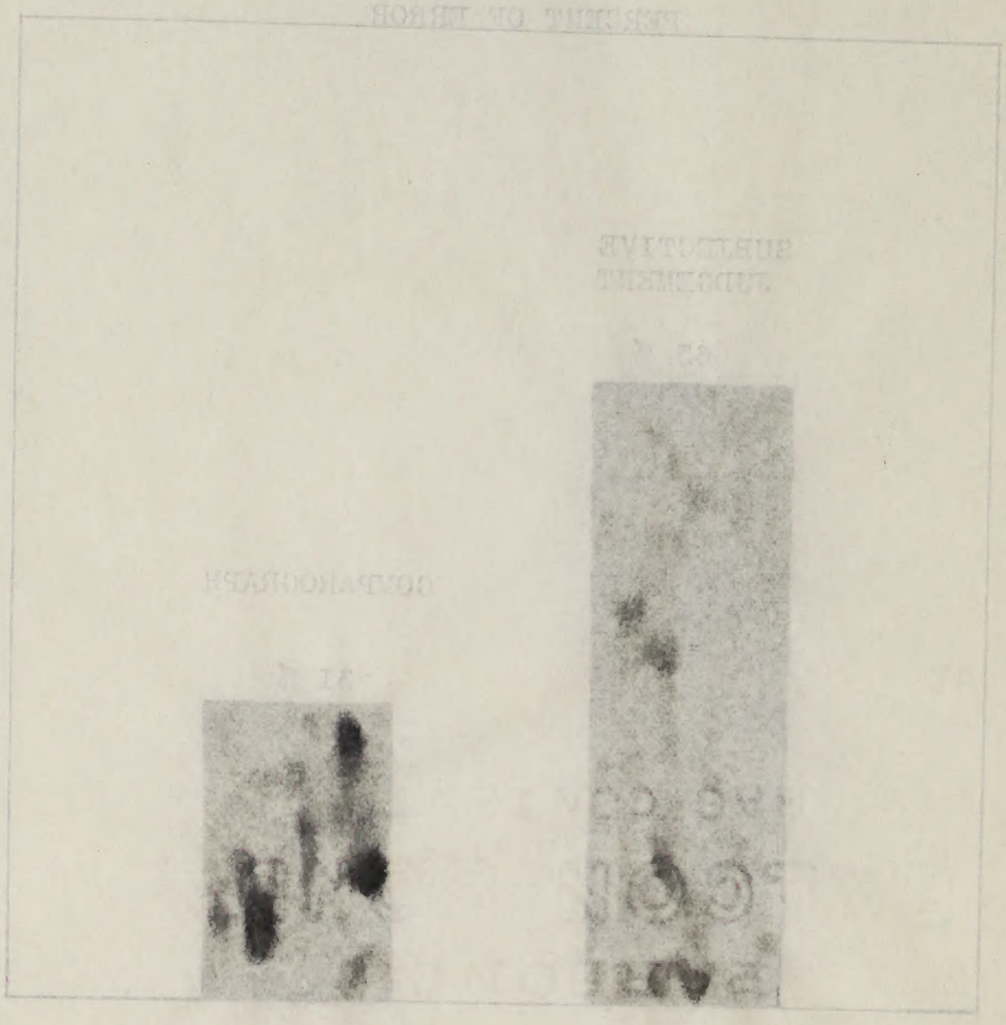


Figure 5



THE RESULT OF THE SUBJECTIVE JUDGEMENT OF SEVENTY-SIX JUDGES IN GRADING SILHOUETTES

ACTUAL GRADE	JUDGES' SUBJECTIVE JUDGEMENT
D	DCDDCCDCCDCCDCCDDCCCDDDDDDBCDCCDCCCBCCCCBCBCC
	DCCCCBDDCD
A	BBBBBCBBCBBABBBBCBBBBBCBBBBBCBBBAABBBBBCBBABC
	BBBBBAABABA
C	CDCCCCCCCCCCDCCDCCDCCCDCCCDCCCCBCCDCCCDBBBDDDD
	DBCCCCBCCC
B	CBCBBBCAADBBABAABAABBBBBABABBBABABACABAAAACBA
	BABCDBBADB
D	BCDCBBDAACBCBBCCBCCCCBCABCBDBDCCCBCADBBDBDCBB
	BBBDCCDCBB
A	AAAABBAABCAAAABBABABAAABBAAAAACBAAAAAAAAABAAA
	ACACABBBBB
C	CCCCCCCBCCBCDCDCCCCCCDCCCCCCCCCCCBDBDCCCCDCDBB
	CCCCCCBBCCCCCDACCCCCCCCCCCCCCCCCDC
B	CCCBBBBACBCBCBCBCBCBABBCCBCBBBBAAABABABBBCCBC
	BBBBBBBCCBBBBBCCBABBBBAABCBBBAAB
D	DDDDDDDDDDDCDDDDDDCDDCDDDDDDDDDDDDDDDCDDDDDD
	DDDDCDDDDDDDDDDDDDDDDDDDCDDDDDD
A	BACBBBACBAAABABAABABBAAAABBBBAAABCAABABAABBBB
	ACACABABBBBABBBBBBADBAABACBAAABB

Table I

THE RESULT OF SEVENTY-SIX JUDGES USING THE COMPAROGRAPH

ACTUAL SCORE	JUDGES AWARD
A	ABAAAAAAAAAAAAABBAAAAAAAAAAAAACAAAAAAAAAAABAA
	AAAAABAAAA
C	DCBBCCCCCDCCCCCCDCCCCBCCCCCCBBCCCCCCCCCBBCCCCB
	CCCBCCBCCC
A	BCBBBBBBBCBBBBAACBBBBBBBACCBAABBAABBBAABBBBBA
	BBBBBBBBBB
D	CCCCCBCCBBDCCCCCBCBCBBCCBCDCCCBCBBBBCCBDCCCCC
	DDCDDCCCCC
D	DCDDDDDDDDCDDDDDCCDDCCDCDDDDDCDDDCDDDDCDCCCCD
	DDCDDDCDDD
B	ACAABBBBACBCBCCCBBBBBCCBBCBBCCBCBABCABBCCBBBBB
	BBCCBABBB
D	DDDDDDDDDDCDDDDDDDDDDDDDDDCDDDDDDDDDDDDDCDDDD
	DDDDDDCDDDDDDDDDDDDDDDDDDDDDD
B	BBBCABBBBCCBCBBBBCCCAAABABABBBBBACCBBBBBBBBBB
	BBBBBBBBBBBBBBBBBBBBBBBBBBBBB
A	AABAAAAABAAAAAABAABAAAAAAAAAABCCCAACCAAAAAAAA
	AACAACAAAAACAAAACAACAACAACAACAAA
C	CCDCCCCDCBCCCCCCBCCCCCCDCCCDCCCCCCBDCCCCDCCCB
	CCCCCCCCCCCCCDCCCCDDBCCDCCCDCCBC

Table 2

THE RESULT OF SEVENTY-SIX JUDGES USING THE CONTRACOSTALPH

ACTUAL SCORE	JUDGES AWARD
A	AAAA

THE RESULT OF THE SUBJECTIVE JUDGEMENT OF SEVENTY- SEVEN JUDGES IN GRADING SILHOUETTES

ACTUAL GRADE	SUBJECTIVE JUDGEMENT
B	AABABAABACBBABABABAACBABBBCBBBABACBBCCBBCBBCBDBBBB
	ABABBABAADBBBBBCCBABABBBCA
D	DDDDDDDDDDDDDDDDDDDDDDDDDCDDDDDDDDDDDDDDDDDDDDDD
	DDDDDDDDCDDDDDDDDDDDDDDDDD
C	BBCBCCBCBCCCCABCCCCCCCCCCBBCCCCBCBCBDCCCCCCCCBCCCBBC
	CBBBCCCBBCCCDBCCDCCBCCABBC
A	CAAAAAAAABAAABAABBBBAABBBAAAAAAAAAAABCAABBAACACBABA
	BABBAAAABBBAABBAAAAAACDABC
D	CCCCCCBCBCCCDCBCCCCCDCCCBCBBBCCCCBCCCBCDBDDDCCCCDC
	CBCCDCCCCCCCBCCBBCCCBDCCCD
A	BABBBBAAABBBBBCBBBBCCABBBBCAABBBCAAABBBCABBCBCBBBB
	ABBAABABBBCABAABCBBBBACCAB
D	CCCDCCCCCCDDDDCDDDDDCDCCBDCCCDCDDCDDDCCDCDDDCDCDDC
	DDDCDDCDCDDCDCDCCCCCDDCBDD
C	CBBDBDBBBCCBDBACCCDCBCBBBCCDACCBBCBACCDABBDBDBDCCC
	BBBBBBBDBBCCCDCBBCBBBBCBCB
B	BABCBBBAABAABCBABBBAAABABBABBBAABBBBBAACABABABBCAB
	AABABBBABAACCAACBBABCABBBB
A	AAAAAAABCBAAAABAAAABABAAAABAAAAAAAABAAABABABAAAAAA
	AABABCAAABAAABAAAAAABAAAAA

Table 3

THE RESULT OF SEVENTY-SEVEN JUDGES USING THE COMPAROGRAPH

ACTUAL GRADE	JUDGES' AWARD
A	AAAAAAAAAAAABAAAACAABAAAAAAAAAAAAAAAAAABAAAAAAAAAAA
	AAAAAAAAAAAAAAAAAAAAAAA
D	DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD
	DDDDDDDDDDDDDDDDCDDDDDDD
C	CBBCCBCCCCCCCCCCBCCCBCBCCBCCCBBABBCBCCCCCCBCCCBCCDDDC
	CCBBCBCBBCCBCCCCCCDDDDDC
B	ABBBBBCCBBBBBCBBCCBBBBBBBBBBCCBCBBCBCBBBBBCBBBBBBBBBB
	ABBCBCBCBCCBBCCBCCBBBCBC
D	CCCCCCCDBDCBCDDDCDCCDDDDDCCDCCDCCDCBBCCDCDCCCDDDDCCCC
	DCCCCDDCDDDBCDDDDDDDCBDC
A	AAAAAAAAAAAAAAAAAAAAABAAAAAAAAAAABAAAAAAAAAABAAAAAAAA
	AAABAAAAAABAAAABAAAABAAA
C	DCCBCBCCBDCCDBDCCCCCCDCCCCCBCDDDBBCDCCCCCDCCCCBBCCBCC
	CCCCCCBCCCCCBDCCCCDBCCDC
D	CCCCCCCDBDCBCDDDCDCCDDDDDCCDCCDCCDCBBCCDCDCCCDDDDCCCCD
	CCCCDDCDDDBCDDDDDDCBDCD
A	BBBBBBBBAAABBBBBBABBBABBBBBABBBBAABBABBBBBAABBBABBBBA
	BAABBABBBBBABBBBBCBABBB
B	CBBDBCBBACBBBBBBBCCCBCBBABBCBBCBBBBCCCCCBBBBBDCCCCBBD
	CCCCBBBCCBCBCCCCCCCDCCC

Table 4

CHAPTER 5

THE RELIABILITY

To determine the reliability coeffecient of the Comparograph a judge was asked to grade 50 silhouettes of known value and to give each a rating of either A,B, C, or D. The test was then repeated using the same 50 silhouettes. From the results of these tests a scattergram was made which showed what grade the judge gave the same silhouette on each test.

The actual reliability coeffecient was determined by means of the mean square contingency. This showed that C was .79 and correcting this for broad categories it was raised th .9I.

To check this the whole test was repeated with another judge. The results on this second test showed that C was .79 also, and correcting this for broad categories it was likewise .9I.

A third test was conducted with a new judge. The results of this third test showed C to be .76 and the correction for broad categories to be .88.

From this four-way scattergram it would have been impossible to obtain a "C" reliability coeffecient above .89

CHAPTER 5

THE RELIABILITY

THE RELIABILITY OF ONE JUDGE IN GRADING THE SAME 50 SILHOUETTES ON TWO SEPARATE TESTS

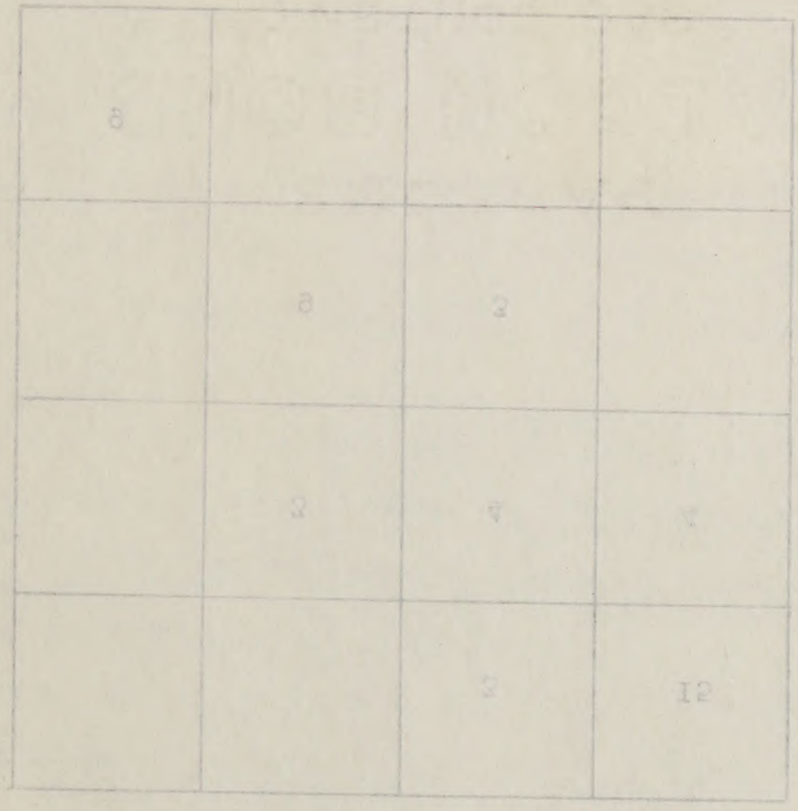
SCATTERGRAM

	A	B	C	D
D			3	I5
C		3	4	4
B		9	3	
A	9			

RELIABILITY COEFFECIENT- .79

CORRECTION FOR BROAD CATEGORIES---------.9I

Table 5



RELIABILITY BETWEEN TESTS

B-B	D-D	B-B
D-D	B-C	A-A
C-B	D-D	D-D
B-B	D-C	C-C
A-A	B-B	C-D
C-D	C-C	D-D
D-D	D-D	B-C
A-A	C-D	B-B
B-C	D-D	A-A
B-B	B-B	C-C
D-D	D-C	D-D
C-B	A-A	D-D
D-D	B-B	A-A
D-D	D-C	C-D
B-B	A-A	D-D
A-A	A-A	D-D
C-C	C-B	

Table 6

RELIABILITY RETWEEN TESTS

B-B	D-D	B-B
D-D	B-C	A-A
C-B	D-D	D-D
B-B	D-C	C-C
A-A	B-B	C-D
C-D	C-C	D-D
D-D	D-D	B-C
A-A	C-D	B-B
B-C	D-D	A-A
B-B	B-B	C-C
D-D	D-C	D-D
C-B	A-A	D-D
D-D	B-B	A-A
D-D	D-C	C-D
B-B	A-A	D-D
A-A	A-A	
D-C	C-B	

THE RELIABILITY OF THE SECOND JUDGE IN GRADING THE SAME 50 SILHOUETTES ON TWO SEPARATE TESTS

	A	B	C	D
D			I	7
C		3	7	4
B		I2	4	
A	I2			

RELIABILITY COEFFECIENT .79

CORRECTION FOR BROAD CATEGORIES--.9I

Table 7

RELIABILITY BETWEEN TESTS

C-B	C-B	A-A
B-B	C-C	C-C
B-B	A-A	D-D
A-A	C-D	B-B
D-D	C-C	D-C
C-D	B-B	C-B
B-C	B-C	A-A
A-A	A-A	C-C
B-C	B-B	D-D
D-D	C-D	B-B
C-C	B-C	A-A
A-A	A-A	B-B
B-B	B-B	C-D
D-D	D-D	A-A
B-B	C-C	B-B
A-A	A-A	C-C
D-D	B-B	

Table 8

RELIABILITY BETWEEN TESTS

C-C	C-C	A-A
B-B	C-C	B-C
C-B	A-A	D-D
A-A	D-D	B-B
D-C	C-C	D-C
D-C	B-B	C-B
C-D	C-C	A-A
A-A	A-A	C-D
C-B	C-B	D-C
D-C	D-D	B-B
B-C	C-C	A-A
A-A	A-A	C-C
B-B	B-B	C-C
D-D	D-D	A-A
C-C	C-C	B-B
A-A	A-A	C-C
D-D	B-B	

Table 9

REPLICABILITY BETWEEN TESTS

C-C	C-C	A-A
B-B	C-C	B-C
C-B	A-A	D-D
A-A	D-D	B-B
D-C	C-C	D-C
D-C	B-B	C-B
C-D	C-C	A-A
A-A	A-A	C-D
A-B	C-B	D-C
D-C	D-D	B-B
B-C	C-C	A-A
A-A	A-A	C-C
B-B	B-B	C-C
D-D	D-D	A-A
C-C	C-C	B-B
A-A	A-A	C-C
D-D	B-B	

Table 9

THE RELIABILITY OF THE THIRD JUDGE IN GRADING THE SAME 50 SILHOUETTES ON TWO SEPARATE TESTS

	A	B	C	D
D			5	6
C		4	II	2
B		8	2	
A	I2			

RELIABILITY COEFFECIENT .76

CORRECTED FOR BROAD CATEGORIES--.88

Table IO

A	15			
B		8	5	
C		4	11	3
D			2	9

CHAPTER 6

SUMMARY AND CONCLUSION

Earlier in this paper it was stated that a method of grading posture would be discussed that not only would increase the validity and reliability of the present method, but was also time saving and economical. These conditions have been fulfilled as the Comparograph has increased the validity over the old subjective method by 47.5 percent, and has a reliability coeffecient of .79, which when corrected for broad categories is .9I, The cost of taking the picture is practically negligable, while the time involved is far less than many of the other methods used.

The Comparograph can be used by the expert or the novice with equal effeciency. As no intricate apparatus is needed and as no complicated methods of determining the subjects score arerequired, the Comparograph is a simple method of grading posture that can be used in almost any school, especially those already using the silhouetteograph.

The Comparograph is adaptable to both sexes and subjects of all ages. For girls or children, naturally a standard of excellent posture for that particular group will be necessary.

BIBLIOGRAPHY

Drew, L. " Individual Gymnastics"Lea and Febiger Co.

Children's Bureau, U.S. Dept. of Labor, Wash. D.C. I926

Goldthwait, Joel."The Relation of Posture to Human Effecie ncy," Am. Journal of Orthopoedic Surgery.

Bancroft,J.H. "The Posture of School Children," I920

Crampton,W.C. "Work-a-Day Test of Good Posture," Am. Phys. Educ. Review I925

Lowman, C.L. "Preventive and Prophylactic Orthopard-ic Practice," Am. Journal of Orthopoedic Surgery. I92I

Cureton, T.K. "Reliability and objectivity od the Springfield Bostural Measurements," Suppl. to the Research Quartly of the Am. Phys. Educ. Ass., May,I935

Brownell,C.L. " A Scale For Measuring The Antero-Post. Posture of Ninth Grade Boys," Teachers College,Columbia Univ. Contributions To Education No. I923

Klein, A. "Posture Standards," Child Health Nov. I924

Lovett, R.W. "Lateral Curvature of the Spine and Round Shoulders, Blakiston Co.

U.S. Dept of Labor, "Posture Exercises," Children's Bureau Publication No I65

Bobrick,G.A. "Hygenic Requirements of School Furniture," N,Y. Exchange Printing Co.

Cocroft, S. "Poise and Symmetry of Figure," Headington Co.

Schwartz,L. "Studies in Physical Developement and Posture." Washington, I928

White House Conference on Child Health and Practices.

Devan, S.A. " Exercise without Exercice," Mead and Co. I934

Dickson, F.D. "Posture and it's Relation to Health," J.B. Lippinsalt Co Phil.

Goldthwait, J. "The Body Posture."

Mosher, E.M. "Habits of Posture a Course of Deformity and Displacement of the Uterus. N.Y. I927

Richardson, F.H. "The Pre-school Child and His Posture," Putman Co. N.Y. I930

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